Package ‘diffusion’

October 13, 2022

Type Package

Title Forecast the Diffusion of New Products

Version 0.2.7

URL https://github.com/mamut86/diffusion

BugReports https://github.com/mamut86/diffusion/issues

Description Various diffusion models to forecast new product growth. Currently the package contains Bass, Gompertz and Gamma/Shifted Gompertz curves. See Meade and Islam (2006) <doi:10.1016/j.ijforecast.2006.01.005>.

License GPL (>= 2)

Encoding UTF-8

LazyData true

Imports dfoptim, nloptr, systemfit

RoxygenNote 6.0.1

NeedsCompilation no

Author Oliver Schaer [aut, cre],
Nikolaos Kourentzes [aut]

Maintainer Oliver Schaer <info@oliverschaer.ch>

Repository CRAN

Date/Publication 2018-01-05 18:26:34 UTC

R topics documented:

`difcurve` *Calculates the values for various diffusion curves, given some parameters.*

Description

This function calculates the values of diffusion curves that can be of `"bass"`, `"gompertz"` or `"gsgompertz"` type, given some parameters.

Usage

```
difcurve(n, w = c(0.01, 0.1, 10), type = c("bass", "gompertz",
  "gsgompertz"), curve = NULL)
```

Arguments

`n`	number of periods to calculate values for.
`w`	vector of curve parameters (see note). If argument curve is used, this is ignored.
`type`	diffusion curve to use. This can be "bass", "gompertz" and "gsgompertz". If argument curve is used, this is ignored.
`curve`	if provided `w` and `type` are taken from an object of class `diffusion`, the output of `diffusion`.

Value

Returns a matrix of values with each row being a period.

Note

`w` needs to be provided for the Bass curve in the order of `"p", "q", "m"`, where "p" is the coefficient of innovation, "q" is the coefficient of imitation and "m" is the market size coefficient.

For the Gompertz curve, vector `w` needs to be in the form of `("a", "b", "m")`. Where "a" is the x-axis displacement coefficient, "b" determines the growth rate and "m" sets, similarly to Bass model, the market potential (saturation point).

For the Shifted-Gompertz curve, vector `w` needs to be in the form of `("a", "b", "c", "m")`. Where "a" is the x-axis displacement coefficient, "b" determines the growth rate, "c" is the shifting parameter and "m" sets, similarly to Bass model, the market potential (saturation point).

Author(s)

Oliver Schaer, <info@oliverschaer.ch>,
Nikoloas Kourentzes, <nikoloas@kourentzes.com>

See Also

diffusion for fitting a diffusion curve.

Examples

```
difcurve(w=c(0.01,0.1,10),20)
```

---

diffusion *Fit various diffusion curves.*

Description

This function fits diffusion curves that can be of "bass", "gompertz" or "gsgompertz" type.

Usage

```
diffusion(x, w = NULL, cleanlead = c(TRUE, FALSE), prew = NULL, l = 2,
  cumulative = c(TRUE, FALSE), pvalreps = 0, eliminate = c(FALSE, TRUE),
  sig = 0.05, verbose = c(FALSE, TRUE), type = c("bass", "gompertz",
  "gsgompertz"), optim = c("nm", "hj"), maxiter = Inf, opttol = 1e-06)
```

Arguments

x	vector with adoption per period
w	vector of curve parameters (see note). If provided no estimation is done.
cleanlead	removes leading zeros for fitting purposes (default == TRUE)
prew	Experimental. Ignore!
l	the l-norm (1 is absolute errors, 2 is squared errors).
cumulative	If TRUE optimisation is done on cumulative adoption.
pvalreps	Experimental. Ignore!
eliminate	Experimental. Ignore!
sig	Experimental. Ignore!
verbose	if TRUE console output is provided during estimation (default == FALSE)
type	diffusion curve to use. This can be "bass", "gompertz" and "gsgompertz"
optim	optimization method to use. This can be "nm" for Nelder-Meade or "hj" for Hooke-Jeeves.
maxiter	number of iterations the optimser takes (default == 10000 for "nm" and Inf for "hj")
opttol	Tolerance for convergence (default == 1.e-06)

Value

Returns an object of class `diffusion`, which contains:

- `type` diffusion curve type used
- `call` calls function fitted
- `w` named vector of fitted parameters
- `x` actuals
- `fit` fitted values of model
- `frc` forecasts for future periods. This is `NULL` until `predict.diffusion` is called.
- `mse` insample Mean Squared Error
- `prew` the `w` of the previous generation
- `pval` p-values for `w`

Bass curve

The optimisation of the Bass curve is initialised by the linear aproximation suggested in Bass (1969).

Gompertz curve

The initialisation of the Gompertz curve uses the approach suggested by Jukic et al. (2004), but is adapted to allow for the non-exponential version of Gompertz curve. This makes the market potential parameter equivalent to the Bass curves's and the market potential from Bass curve is used for initialisation.

Gamma/Shifted Gompertz

The curve is initialised by assuming the shift operator to be 1 and becomes equivalent to the Bass curve, as shown in Bemmaor (1994). A Bass curve is therefore used as an estimator for the remaining initial parameters.

Note

vector `w` needs to be provided for the Bass curve in the order of `"p", "q", "m"`, where "p" is the coefficient of innovation, "q" is the coefficient of imitation and "m" is the market size coefficient.

For the Gompertz curve, vector `w` needs to be in the form of `("a", "b", "m")`. Where "a" is the x-axis displacement coefficient, "b" determines the growth rate and "m" sets, similarly to Bass model, the market potential (saturation point).

For the Shifted-Gompertz curve, vector `w` needs to be in the form of `("a", "b", "c", "m")`. Where "a" is the x-axis displacement coefficient, "b" determines the growth rate, "c" is the shifting parameter and "m" sets, similarly to Bass model, the market potential (saturation point).

Parameters are estimated by minimising the Mean Squared Error with a Subplex algorithm from the nloptr package.

Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

References

- For an introduction to diffusion curves see: Ord K., Fildes R., Kourentzes N. (2017) Principles of Business Forecasting 2e. *Wessex Press Publishing Co.*, Chapter 12.
- Bass, F.M., 1969. A new product growth for model consumer durables. Management Science 15(5), 215-227.
- Bemmaor, A. 1994. Modeling the Diffusion of New Durable Goods: Word-of-Mouth Effect versus Consumer Heterogeneity. In G. Laurent, G.L. Lilien and B. Pras (Eds.). Research Traditions in Marketing. Boston: Kluwer, pp. 201-223.
- Jukic, D., Kralik, G. and Scitovski, R., 2004. Least-squares fitting Gompertz curve. Journal of Computational and Applied Mathematics, 169, 359-375.

See Also

`predict.diffusion`, `plot.diffusion` and `print.diffusion`.

Examples

```
fitbass <- diffusion(tsChicken[, 2], type = "bass")
fitgomp <- diffusion(tsChicken[, 2], type = "gompertz")
fitgsg <- diffusion(tsChicken[, 2], type = "gsgompertz")

# Produce some plots
plot(fitbass)
plot(fitgomp)
plot(fitgsg)
```

`plot.diffusion` *Plot a fitted diffusion curve.*

Description

Produces a plot of a fitted diffusion curve.

Usage

```
## S3 method for class 'diffusion'
plot(x, cumulative = c(FALSE, TRUE), ...)
```

Arguments

x	diffusion object, produced using diffusion.
cumulative	If TRUE plot cumulative adoption.
...	Unused argument.

Value

None. Function produces a plot.

Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

See Also

diffusion.

Examples

```
fit <- diffusion(tsChicken[, 2])
plot(fit)
```

---

predict.diffusion *Predict future periods of a fitted diffusion curve.*

Description

Calculates the values for h future periods of a fitted diffusion curve.

Usage

```
## S3 method for class 'diffusion'
predict(object, h = 10, ...)
```

Arguments

object	diffusion object, produced using diffusion.
h	Forecast horizon.
...	Unused argument.

Value

Returns an object of class `diffusion`, which contains:

- `type` diffusion curve type used
- `call` calls function fitted
- `w` named vector of fitted parameters
- `x` actuals
- `fit` fitted values of model
- `frc` forecasts for future periods.
- `mse` insample Mean Squared Error
- `prew` the `w` of the previous generation
- `pval` p-values for `w`

Note

This function populates the matrix frc of the `diffusion` object used as input.

Author(s)

Oliver Schaer, `<info@oliverschaer.ch>`,

Nikoloas Kourentzes, `<nikoloas@kourentzes.com>`

See Also

`diffusion`.

Examples

```
fit <- diffusion(tsChicken[, 2])
fti <- predict(fit,20)
plot(fit)
```

`print.diffusion` *Print a fitted diffusion curve.*

Description

Outputs the result of a fitted diffusion curve.

Usage

```
## S3 method for class 'diffusion'
print(x, ...)
```

Arguments

x	diffusion object, produced using diffusion.
...	Unused argument.

Value

None. Console output only.

Author(s)

Oliver Schaer, <info@oliverschaer.ch>,

Nikoloas Kourentzes, <nikoloas@kourentzes.com>

See Also

diffusion.

Examples

```
fit <- diffusion(tsChicken[, 2])
print(fit)
```

---

tsAc *Time series: Assassins Creeds*

Description

A dataset containing the weekly sales of Assassins Creeds game.

Format

A matrix with 380 observations and 8 variables

ac1 Assassins Creed 1

ac2 Assassins Creed 2

ac3 Assassins Creed 3

ac4 Assassins Creed 4

ac5 Assassins Creed 5

ac6 Assassins Creed 6

ac7 Assassins Creed 7

ac8 Assassins Creed 8

References

VGChartz

`tsBroadband` *Time series: Broadcast subscribers*

Description

A dataset containing the broadcast subscribers to UK market 4Q 2011 to 2Q 2016.

Format

A data frame with 51 observations and 4 variables

Time Quarters

DSL Adoption of DSL subscribers

Cablemodem Adoption of CableModem users

FTTPb Adoption of FTTPb sales

References

Telecoms Market Matrix

`tsCarstock` *Time series: Stock of cars*

Description

A dataset containing the yearly stock of cars in the Netherlands (1965-1989).

Format

A data frame with 25 observations and 3 variables

year Year

raw Raw stock numbers

smoothed Smoothed stock numbers as described by Franses (1994)

References

Franses, P.H. 1994. Fitting a Gompertz curve. Journal of Operational Research Society, 45, 109-113.

tsChicken *Time series: Chicken weight*

Description

A dataset containing the average weekly female chicken weight.

Format

A data frame with 13 observations and 2 variables

time Weeks since birth

weight Weight of the female chicken in Kg

References

Jukic, D., Kralik, G. and Scitovski, R. 2004. Least-square fitting Gompertz curve. Journal of Computational and Applied Mathematics, 169, 359-375.

tsIbm *Time series: Sales of IBM Computers*

Description

A dataset containing the first four generations of yearly IBM general-purpose computers installations in the USA.

Format

A data frame with 24 observations and 4 variables

SIU1 1st generation

SIU2 2nd generation (starts 6 years after first generation)

SIU3 3rd generation (starts 11 years after first generation)

SIU4 4th generation (starts 16 years after first generation)

Source

`https://goo.gl/VSEkgM`

References

Bass, P.I. and Bass, F.M. 2004. IT Waves: Two Completed Generational Diffusion Models. Working Paper Basseconomics, 1-33.

tsSafari *Time series: Safari Browser market share*

Description

A dataset containing the monthly market share of Safri browser generations from Safari 4.0 to Safari 10.

Format

A data frame with 98 observations and 13 variables

Date Log file date

Safari10.0 Usage of Windows 10

Safari9.1 Market share of Safari browser v 10.0

Safari9.0 Market share of Safari browser v 9.1

Safari8.0 Market share of Safari browser v 9.0

Safari7.1 Market share of Safari browser v 8.0

Safari7.0 Market share of Safari browser v 7.1

Safari6.1 Market share of Safari browser v 6.1

Safari6.0 Market share of Safari browser v 6.0

Safari5.1 Market share of Safari browser v 5.1

Safari5.0 Market share of Safari browser v 5.0

Safari4.1 Market share of Safari browser v 4.1

Safari4.0 Market share of Safari browser v 4.0

Source

http://gs.statcounter.com/browser-version-market-share

tsWindows *Time series: Windows OS Platform Statistics*

Description

A dataset containing the 3WSchools monthly log files of Windows operating system usage from March 2003 until February 2017.

Format

A data frame with 168 observations and 9 variables

Date Log file date

Win10 Usage of Windows 10

Win8 Usage of Windows 8

Win7 Usage of Windows 7

Vista Usage of Windows Vista

WinXP Usage of Windows XP

Win2000 Usage of Windows 2000

Win98 Usage of Windows 98

Win95 Usage of Windows 95

Note

From March 2003 until January 2008 log file is only available bi-monthly. To retain monthly consistency, values have been linearly interpolated

Source

https://www.w3schools.com/browsers/browsers_os.asp

Index